# Protocol Test

## Racal Instruments Wireless Solutions 6204

### CDMA Air Interface Monitor / Emulator

AEROFLEX
A passion for performance.

- cdmaOne (IS-95) and CDMA2000 1X protocol analyzer
- Test automation capability
- Option to upgrade to CDMA2000 1xEV-DO
- Detailed logging of forward and reverse link signaling messages and RLP frames.
- CDG 22, 53, 57 Stage 2 testing
- Handoff and power control testing
- Pilot pollution simulation
- Script driven network emulation
- Easy to use Windows™ user interface
- Own protocol stack for independent solution
- Applications in development, regression testing, and conformance testing

CDMA2000® is a registered trademark of the Telecommunications Industry Association (TIA-USA)

cdmaOne™ is a registered trademark of the CDMA Development Group

*Since its entry into the testing of CDMA mobiles, Aeroflex has led the way in innovative testing of cdmaOne™ and CDMA2000® mobiles and the company continues to be a market leader in the wireless test industry. From development, through production to installation, Aeroflex is renowned for innovative products, designed for the mobile telecommunications industry.*

### PRODUCT DESCRIPTION

The Racal Instruments Wireless Solutions 6204 1X-AIME system is a protocol test system for cdmaOne and CDMA2000 1X mobiles with an option for CDMA2000 1xEV-DO testing. It is designed for use in research and development environments or for use in laboratory conformance and inter-operability testing.

The system acts as a network emulator, and it provides built in logging of signaling procedures to enable full testing and investigation. In this way the system provides a cost effective environment to perform testing.

### APPLICATIONS

The system is able to reduce development costs by providing a comprehensive test tool with diagnostics during development. It can also reduce costs by enabling pre-interoperability testing to be run on a fully independent platform.

### SYSTEM OVERVIEW

The basic system consists of the 6204 Dual Rack Assembly containing two 6304s and RF combiner. Each system can emulate two CDMA 2000 1X Base Stations. A PC to the defined specification is required to control the system.

The system is connected to the Mobile-under-test via the normal RF antenna port using a coaxial cable.

The 6204 1X-AIME system incorporates a full protocol stack. It provides full access to the Layer 3 forward link via the scripting language used. The Layer 2 messaging operates automatically but can be modified by the user to enable Layer 2 testing. All Layer 2 and 3 messages are time stamped and logged for subsequent review. Tests can be run on mobile performance including fax and data performance, mobile power control, pilot pollution, authentication and

encryption, and handoff including 1X / IS95 (and EV-DO where the EV-DO option is installed).

A library of messages specified by IS-95A, -B, ARIB STD-T53 and IS-2000 is provided. Messages may also be modified and new messages can be added.

One of the main applications of the 1X-AIME system is to perform CDG interoperability (stage 2) tests (and IS-919 when EV-DO option is installed). A suite of test cases can be provided to enable this testing to be accomplished efficiently.

To enable the system to be used to its greatest potential, it incorporates a Windows™ user interface that runs on a PC. There is an activity window to display status messages along with a Layer 2 /3 window. A campaign manager is included to allow a series of test cases to be run sequentially.

## FULL SYSTEM DETAILS AND DATA

### FORWARD CODE CHANNELS

The standard 1X-AIME System contains two 6304 Base Station Emulators, each of which supports transmission of up to 16 Forward Code Channels which can be any combination of:

· Fundamental Code Channels

· Supplemental Code Channels

· Supplemental Channels

· Paging Channels

· Sync Channels

· Pilots

Each one of the 16 Code Channels is fully and independently programmable and the following parameters are configurable by the user:

· Frame rate

· Long Code Mask

· Frame Offset

· Quick paging channels

· Power control sub-channel state (where relevant)

One or more of these channels can be used to provide an Orthogonal Channel Noise Source (OCNS) on an otherwise un-used Walsh code.

### FORWARD CDMA CHANNELS

In each 6304 the Forward Code Channels can be combined onto one or two Forward CDMA Channels. The user can program the properties of these Channels independently including:

· PN offset

· Total Channel Output power

· Individual code channel relative powers

· Walsh Code of individual Code Channels

· Propagation delay

In addition to these two Forward CDMA Channels, each 6304 can also transmit another simplified Forward CDMA Channel that contains just a pilot and a random (non-OCNS) noise source. This is ideal for generating a repeatable and accurately controllable level of noise for mobile testing where fading is not needed, for example in Pilot Pollution investigations.

### REVERSE CDMA CHANNEL

Each 6304 supports the reception of one Reverse CDMA Channel that can be:

· Access Channel or

· Reverse Traffic Channel consisting of a Fundamental Code Channel and up to 7 Supplemental Code Channels or up to two Supplemental Channels.

### MULTIPLEX OPTION AND RADIO CONFIGURATION SUPPORT

The 1X-AIME System supports Multiplex Options 1 to 16 (Radio Configurations 1 to 5, one Fundamental and up to two Supplemental Channels or one Fundamental and up to 7 Supplemental Code Channels).

Primary and Secondary traffic is supported for all Traffic Channels.

The user specifies the Multiplex Option to be used in the script and this can then be changed dynamically during the call.

In addition, the user can specify the transmission of various error conditions including:

· Corrupted frame quality indicator

· Corrupted frame bits after adding the frame quality indicator

· Corrupted modulation symbols (after block interleaving)

### SERVICE OPTION SUPPORT

Most non-proprietary Service Options are supported in the 1X-AIME system. Where data service options utilize application Layers above Air Interface Layer 3, standard commercial off-the-shelf (COTS) software is used where applicable.

Summary of Service Options supported:

| ***Service Option Number*** | ***Designated/Type of Service*** |
|---|---|
| 1 | Basic Variable Rate Voice Service (8 kbps) |
| 2 | Mobile Station Loop-back (8 kbps) |
| 3 | Enhanced Variable Rate Voice Service (8 kbps) |
| 4 | Asynchronous Data Service (9.6 kbps) |
| 5 | Group 3 Facsimile (9.6 kbps) |
| 6 | Short Message Services (Rate Set 1) |
| 7 | Packet Data Service: Internet Protocol Stack only (Rate Set 1) |
| 9 | Mobile Station Loop-back (13 kbps) |
| 12 | Asynchronous Data Service (14.4 or 9.6 kbps) |
| 13 | Group 3 Facsimile (14.4 or 9.6 kbps) |
| 14 | Short Message Services (Rate Set 2) |
| 15 | Packet Data Service: Internet of ISO Protocol Stack (14.4kpbs) |
| 18 | Over-the-air Parameter Administration (Rate set 1) |
| 19 | Over-the-air Parameter |

| | |
|---|---|
| | Administration (Rate set 2) |
| 22 | Medium Speed Packet Data Service: Internet Protocol only (RS1 forward, RS1 reverse) |
| 25 | Medium Speed Packet Data Service: Internet Protocol only (RS2 forward, RS2 reverse) |
| 32 | TDSO Test Data (RS1, RS2) |
| 33 | 144 kbps Packet Data |
| 35 | Position Location (RS1) |
| 36 | Position Location (RS2) |
| 54 | IS-2000 Markov (RS1, RS2) |
| 55 | IS-2000 Loopback (RS1, RS2) |
| 4100 | Service Option 4, revision 1 |
| 4101 | Service Option 5, revision 1 |
| 4103 | Service Option 7, revision 1 |
| 32,768 | High Rate Voice Service (13kbps) |
| 32,798 | Rate Set 1 Markov (8k) |
| 32,799 | Rate Set 2 Markov (13k) |

Other options may be supplied if required.

### SYSTEM CONTROL

The 1X-AIME System uses a COM compatible software interface, therefore the user can use the script interpreter built into the User Interface.

### SCRIPT LANGUAGE

The 1X-AIME uses an ActiveX scripting engine that allows SAX BASIC (Visual Basic) Script to be used to control the system.

### PROCEDURES AND TEST CASES SUPPLIED

The standard 1X-AIME system is supplied complete with a number of example-scripted procedures based on IS-2000. These can be used directly or the user can incorporate them into other scripts. They can be freely copied and modified subject to licence. These procedures include testing aspects of handoff, SMS, pilot pollution, power control, propagation delay, call setup, etc..

A facility is also provided to run a sequence of test cases as a test campaign. The user can vary the length and the content of the test campaign altering the parameters between successive runs to enable comprehensive test campaigns to be created.

### CONTROL OF EXTERNAL EQUIPMENT

The 1X-AIME system is capable of controlling additional external equipment (not supplied with the system), normally via the PC. Such equipment could include Multi-path Fading Simulators (Channel Simulators), or AWGN generators.

Any standard PC interface can be used including GPIB, RS232, and Ethernet and, as long as standard API interface driver software is available, then the external equipment can be controlled from within the script

### PROTOCOL TESTING

Signaling messages are completely controlled by the script. These can be the example scripts provided with the System, the User's own scripts or the optional Conformance Test Cases available with the System.

While the script is running, the system logs all signaling messages, on both Forward and Reverse links on the PC for future review.

The user has full control of the protocols, procedures and timings used via the script. The user can send and receive any signaling messages and parameters in those messages, including incorrect or erroneous messages. The user can also construct new messages not yet in the IS-2000 message catalog.

The timing of messages sent on the Forward Link can be set in 20 ms intervals relative to the reception of messages on the Reverse link, or relative to system time. All logged messages are also time stamped with the time they are sent or received by the 1X-AIME System.

The user can make the signaling procedures as simple or as complex as required for the type of testing to be performed.

All the Message fields and their contents in each message can be reviewed including the common identification fields where relevant.

The messages can also be filtered to reduce the amount of information displayed. A "find" feature is included.

### RETRIEVABLE AND SETTABLE PARAMETERS

The Retrieve Parameters Message, Parameters Response Message and the Set Parameters Message are all fully supported and ID values of up to 65535 may be used to allow manufacturer - specific parameters to be investigated

### FAX AND DATA TESTING

The 1X-AIME system allows the user to perform functional tests of Fax and Data calls and data transfer very simply and easily. All the necessary protocols are provided in the 1X-AIME software. Initially these upper Layer protocol stacks are not user-accessible, but future enhancements will allow testing of these stacks (e.g. T30, RLP etc) if required. Consult your local Sales Representative for further information.

### FAX TESTING

The necessary protocol stack up to, and including, the T30 protocol (RLP, PPP, TCP/IP, App Interface, T30) is included in the System software. The script has a number of commands to control the Fax procedures.

The Fax data itself is supplied in TIFF format and users can supply their own data or use the three ITU files supplied with the system (T.24 Figures 01, 09 and 10). This method of providing Fax capability allows for many more future enhancement possibilities than the method of using a standard Fax software package.

### MOBILE STATION POWER CONTROL TESTING

The 1X-AIME system provides the user with all the necessary low-level control to perform comprehensive testing of Mobile Power Control.

Normally the system uses automatic Closed Loop Power Control of the Mobile to hold the Mobile power at an optimum level. However, the user also has full manual control of this process via the script.

Each 6304 Base Station Emulator can be configured with one or two fundamental Forward code channels each with independent power control sub-channels. When required, the user has full control of the power control bit puncturing on each code channel on a 20ms basis.

While the System has not been designed to provide accurate absolute power measurement of the Mobile's transmit power, measurement of the relative power of the Mobile's steps can be performed by the

System and absolute power can be measured with other external equipment. This allows most power control scenarios to be simulated and tested

### PILOT POLLUTION TESTING

The fine control of the 6304, means the 1X-AIME System is ideal for simulating pilot pollution scenarios for R&D testing of Mobile Handsets.

The output power of the Forward Channels in each code channel can then be varied over a 20 db range with 0.05 db resolution with a time resolution down to 20 ms. This allows the user to rapidly vary the relative pilot levels in a completely controlled and repeatable manner.

### AUTHENTICATION AND ENCRYPTION TESTING

For CDMA2000 1X, Authentication, Voice Privacy and Message Encryption are all fully supported in the 1X-AIME System.

Authentication can be tested by using known challenge/response pairs in the script, or by the user implementing the required Authentication algorithm in a script. Alternatively the user can simply ignore the Mobile's response in the script.

Encryption can be tested by using a known Public or Private Long Code mask in the script.

### HANDOFF TESTING

The 1X-AIME system is ideal for setting up and investigating different handoff scenarios. All types of soft and hard handoffs can be simulated.

Within a single 6204 Dual Rack each 6304 can be configured to simulate up to two Base Stations can be configured for performing two-way soft handoff. For hard handoff the second 6304 in the rack is also used. It is possible to use a second 6304 for three or more way soft handoff.

A standard 1X-AIME System, with two 6304s, can support up to 4-way Soft Handoff, as well as Hard Handoff to a different frequency, on any call type, including MDR data calls.

As part of handoff testing it is possible to adjust PN offsets, frame offsets, frequency and relative power output levels as well as a differential delay between Base Stations (to simulate Base Stations at different distances). It is also possible to connect further systems together to increase the number of simulated Base Stations for testing with more complicated scenarios.

### LOGGING FACILITIES

### SIGNALING MESSAGE LOGGING

All forward and reverse link signaling messages are detected by the test system and passed to the Controller PC for time stamping and logging. These messages are decoded and made available for display at the GUI.

### RADIO LINK PROTOCOL LOGGING

RLP signaling messages are logged with other signaling messages. RLP packets can be logged under user control from a test script. Forward and reverse packets are logged separately.

### MARKOV DATA LOGGING

Good, Data Error, Rate Error and Erased frames values are displayed and logged for a Markov Data call.

### USER INTERFACE

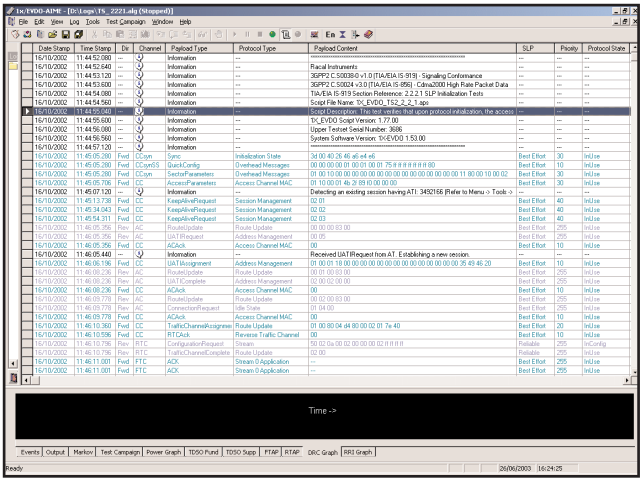
The Windows User Interface that runs on the PC allows the user to control all aspects of the testing. It also provides extra features for use in the post processing of results.

### ACTIVITY WINDOW

An Activity window displays various status messages to the user during the running of a Test Script. It can also be used to prompt the user as necessary during testing for example "Please place a call from the Mobile now".

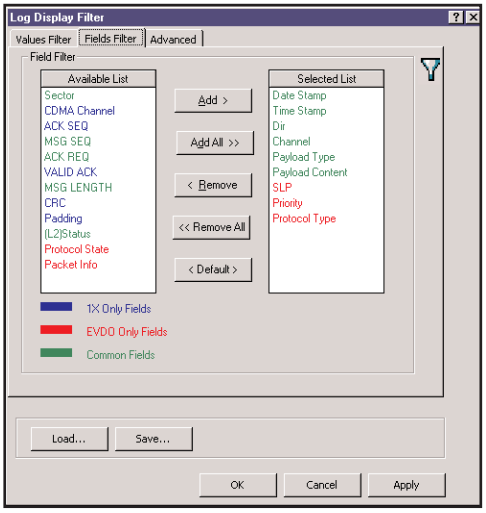
### SIGNALING WINDOW

This displays the signaling messages, either in real time during a test or for subsequent review from a saved file. When displaying messages in real time during a test run the window can be 'paused' so that an area of interest can be viewed without waiting for the test run to complete.



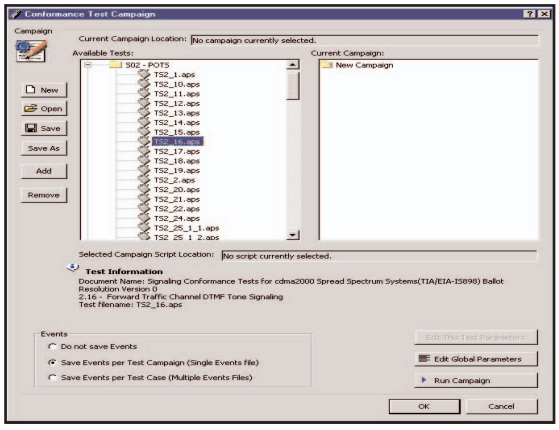
### FILTERING AND SEARCHING

All messages can be 'filtered' so that only those of interest are displayed in the window. In addition the ability to quickly search for a particular message or event in a saved file is also provided. In this way manipulating and checking the messages after test cases have been run is considerably simplified and problems encountered with the mobiles under test can be quickly and easily found.




## CAMPAIGN MANAGER

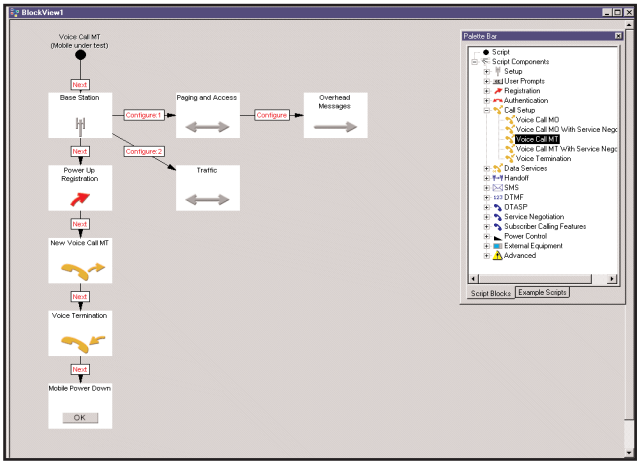
A campaign manager is included within the system to provide the automation of tests. This enables a series of tests to be assembled so that they can be run without operator intervention. This is particularly useful for applications including regression testing. By using this facility considerable time savings are possible.




## SCRIPT WIZARD

The script wizard allows all 1X-AIME users to automatically create Sax Basic scripts to IS-2000 and IS-95B standards. Once created, the scripts are ready for immediate use on the 1X-AIME system.

Scripts are assembled from an extensive library of script 'blocks' via a user-friendly graphical interface. Each script block is represented by an identifiable CDMA task. Script block parameters may also be modified to suit the particular test application. With the aid of the graphical interface, the selected blocks are simply dropped onto the view and linked together to for the complete script. Example Scripts have been provided. These can be used as provided, or customized for other purposes by editing the parameters, swapping, adding or removing blocks.




## COMPLETE SYSTEM

The 1X-AIME is normally supplied as a 6204 Dual Rack. The system will consist of:

A 6204 Dual Rack containing:

2 off 6304 cdmaOne Base Station Emulator Units

RF Combiner Unit

All necessary interconnection cables etc.

1X-AIME Operating Software and User Manual

Example scripts

# SPECIFICATION

## RF GENERATOR

***FREQUENCY***

***Range***

*832 to 894 MHz*

*1805 to 1870 MHz*

*1930 to 1990 MHz*

***Raster***

*30 kHz or 50 kHz*

***Resolution***

*<1 Hz*

***Accuracy***

*As frequency standard*

***OUTPUT LEVEL***

***Range***

*RF In/Out Mobile Port:-50 to -100 dBm,-50 to -120 dBm (usable)*

*RF Out port on 6303 may be used for output signal only:-20 to -80 dBm, -20 to -100 dBm (usable)*

***Resolution***

*0.05 dBm*

***SIGNAL QUALITY ρ***

*>0.966*

***ACCURACY***

***Total Output Power***

***Relative***

*+1 dB*

***Absolute***

*+5 dB*

***CODE CHANNEL POWER***

***Relative***

*+0.1 dB*

***Dynamic Range***

*20 dB*

***PORTS***

***RF In/Out Mobile Port***

***Connector***

*N type Female*

***Impedance / Coupling***

*50Ω nom / DC*

***VSWR***

*1.2:1*

***Max / min Reverse power***

*10 W RMS*

***6304 RF Out Port***

***Connector***

*TNC female*

***Impedance / Coupling***

*50 Ω nominal / DC*

***VSWR***

*1.2:1*

***Max / Min Reverse power***

*1 W RMS*

## RF RECEIVER

***FREQUENCY***

***Range***

*824 to 849 MHz , 887 to 925 MHz, 1715 to 1780 MHz, 1850 to 1910 MHz*

***Tolerated frequency error***

*±300 Hz (800 MHz band)*

*± 150 Hz (1700 & 1900 MHz bands)*

***Raster***

*30 or 50 kHz*

***Resolution***

*Can be tuned to any receive channel*

***INPUT LEVEL***

***Range***

*RF Duplex Port: +38 to -40 dBm*

***MEASUREMENT ACCURACY (+38 to -20 dBm)***

***Relative***

*±0.4 dB*

***Absolute***

*±2.5 dB*

## FREQUENCY STANDARDS

***EXTERNAL REFERENCE INPUT***

***Connector***

*BNC female*

***Frequency***

*10 MHz*

***Level***

*-2 to +19 dBm*

***Impedance / Coupling***

*50 Ω nom / AC*

***REFERENCE OUTPUT*** ***As reference input***

***Level***

*+9 dBm*

***Impedance/ Coupling***

*50 Ω nom / AC*

***Connector***

*BNC female*

***Output protection***

*Will withstand a permanent short-circuit*

***Internal overall stability***

*For one year ±0.12 ppm*

***SYNCHRONIZATION PORT***

*Timing signals provided*

*20 ms frame clock*

*26.67 ms clock*

*80 ms clock*

*Even second time mark*

*1.25 ms power control group clock*

*Signal synchronized to the insertion of bad or deleted frames*

*Signal synchronized to the start of power control bit sequences*

## GENERAL

***POWER REQUIREMENTS***

***Voltage range***

*85-130 V and 180-246 V*

***Frequency range***

*45-66 Hz*

***Power consumption***

*400 VA MAX (excluding PC)*

***DIMENSIONS AND WEIGHT***

***Dimensions***

*(6203 dual rack) (WHD)* *600 mm x 700 mm x 600 mm*

***Weight***

*60 kg approximately*

***Operating temperature***

*23 ºC ± 1 0ºC*

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Our passion for performance is defined by three attributes represented by these three icons: solution-minded, performance-driven and customer-focused.

*Part No. 46891/194, Issue 1, 04/05*